DATA EVALUATION RECORD

PC Code: 128931/100094 **Dicamba, DGA, and BAPMA Salts**

Reference: Silva, Diecson Ruy Orsolin da, Silva, Edson Dalla Nora da, Aguiar, Adalin Cezar Moraes de, Novello, Bruna Dal'Pizol, Silva, Álvaro André Alba da, & Basso, Claudir José. (2018). Drift of 2,4-D and dicamba applied to soybean at vegetative and reproductive growth stage. Ciência Rural, 48(8), e20180179. Epub August 06, 2018.https://dx.doi.org/10.1590/0103-8478cr20180179

Test material: Unspecified dicamba-containing test material

Common name: Dicamba

Study classification: Supplemental

Primary Reviewer:	Chuck Peck EPA Reviewer	2018.10.30 15:28:00 -04'00' Date
Secondary Reviewer:	Frank Farrugia, Ph.D. EPA Reviewer	2018.10.30 13:31:17 -04'00' Date
Secondary Reviewer:	Michael Lowit, Ph.D. EPA Reviewer	2018.10.30 13:51:14 -04'00' Date

Reviewer Conclusions

This field study evaluated the impact on non-dicamba and non-2,4D resistant soybean (glyphosate resistant cultivar BMX GARRA IPRO) from direct spraying of dicamba or 2,4-D (formulation information not provided). Soybean plants were treated at one of five rates of either dicamba or 2,4-D. A single treatment was made to plants at both the V5 and R2 growth stages. Plants were evaluated for severity of % injury and plant height at 4 weeks post application, as well as grain yield (moisture adjusted) at harvest. Seeds from the harvested plants were germinated in the laboratory to determine impacts on germination and vigor of next-generation plants.

For the purposes of this review, the methods and results related to plant height and grain yield were evaluated. Equations provided in the manuscript allow for the estimation of a 5% effect on plant height and grain yield and were calculated during this review.

Reviewer estimated endpoints

5% Grain Yield Reduction
V5 Exposure = 3.49 g ae/ha
R2 Exposure = 1.03 g ae/ha

5% Plant Height Reduction
V5 Exposure = 0.86 g ae/ha
R2 Exposure = 0.39 g ae/ha

Materials and Methods

Several experiments testing the effects of dicamba on soybeans were conducted between November 2016 and April 2017 at the at Universidade Federal de Santa Maria, in Frederico Westphalen, RS, Brazil, in the classified soil as typical dystrophic red latosol with clay of 600mg dm-3, pH of 6.2 and 3.2% organic matter. During the experiment, the mean temperature were 22.5; 23.0; 24.0; 24.0; 22.1 and 21.2 deg C, and the total rainfall was 116; 169; 120; 225; 174 and 180 mm, to November, December, January, February, March, and April, respectively.

The field trial was established as a randomized complete block design with four replications. Treatments were 2,4-D at rates of 0,5.16, 10.4, 20.8 and 41.5 g ae/ha, and dicamba at 0, 3.7, 7.4, 14.9 and 29.8g ae/ha applied at the V5 and R2 soybean growth stages to simulate drift. The soybean was implemented in no-tillage in cover crop (*Avena sativa*) with pre-plant glyphosate application at 50 and 10 days before planting. A glyphosate resistant soybean cultivar (BMX GARRA IPRO) was planted on November 21, 2016, at 216000 seeds/ha and row spacing was 0.45 m wide. Each experimental plot contained four rows, measuring1.8 m wide and 4.0 m long. The fertilizer was applied at planting at 350 kg/ha of 05-30-10 NPK. To avoid weed competition effects, the study was conducted under weed-free conditions, where the weed postemergence consisted of glyphosate (816 g ae/ha) application at 16 and 29 days after emergence. All herbicide treatments were applied with a CO2-pressurized back-pack sprayer outfitted with 110015 flat-fan nozzles at 100 kPa calibrated to deliver 150 L/ha. Herbicide applications were made with a spray boom with four nozzles spaced 50cm apart. The visible injury was not apparent between adjacent treated plots with herbicides.

Visible estimates of soybean injury were collected at four weeks after treatment (WAT), on a 0 to 100% scale relative to untreated, where0 represented no injury and 100 to complete crop death. In addition, five arbitrarily selected plants for soybean heights, which measured distance from the ground to the tip of the topmost fully expanded leaf. At harvest, the two center rows harvested manually and grain yield was recorded and seed moisture content being adjusted to 13%. Immediately after harvest, samples containing 100g of seeds of each plot were collected and sent to the laboratory for seed germination and vigor analysis. Samples were dried and maintained at 13% moisture and stored at20 - 25°C for three months.

In the laboratory, germination and vigor seed tests were performed, using the rolled paper towel method, which 100 seeds from each treatment in each replication were distributed on two sheets of germination paper previously humidified with distilled water three times greater than its weight, and then covered with a moistened sheet paper. Rolled sheets of paper were placed in plastic bags and positioned in an upright position. These were left in a regulated germinator to maintain the temperature between 25 and 30°C.

After five days, the test the first count was carried out, the abnormal seedlings were count and removed, and normal and vigorous seedlings, expressed as a percentage, represented seed vigor. Percentage of seed germination was performed adding the values reported for normal seedling in the first and last count, after eight days.

Normality tests were performed using residual data procedure and Shapiro Wilk test. Non-transformed means for soybean variables are presented because transformations did not improve the normality of the data. Data were subjected to ANOVA and tested for appropriate interactions. Subsequent linear and nonlinear regression was conducted using Sigmaplot 10.0.

Summary of Relevant Information from Author's Results and Discussion

The authors report that for dicamba both % injury and plant height reductions were greatest for applications made during the V5 growth stage as compared to the R2 growth stage and observed effect increased in a dose response manner (**Figure 1**). Regression equations were provided within the figures. The authors attribute the greater amount of height reduction to the rapid growth during V5 versus the near height maturation during R2.

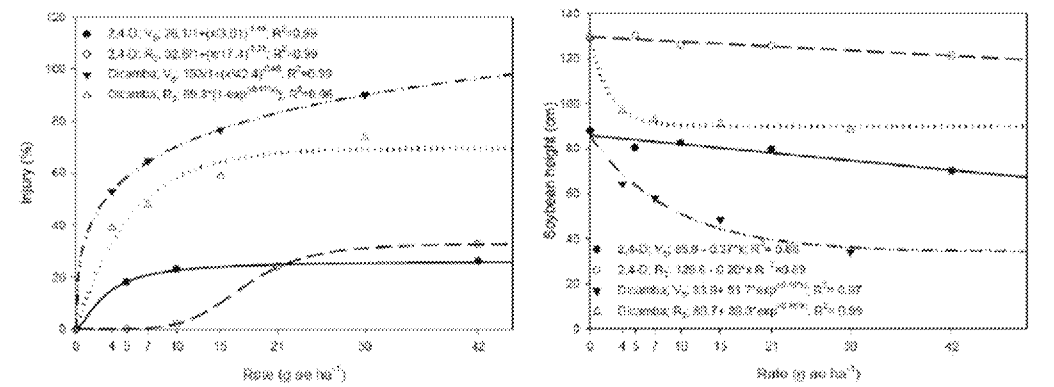

Figure 1 - Injury (%) and soybean height (cm) 4 weeks after treatment of rates of 2,4-D and dicamba applied at the vegetative (V_5) and reproductive (R_2) growth stages.

Linear regressions were fit to describe soybean grain yield loss to dicamba at the V5 growth stage and nonlinear regressions at R2 growth stage (**Figure 2**). Soybean yield reduction was greatest for dicamba at the R2 stage, ranging from 16% to 63%. Regression equations were provided in figures.

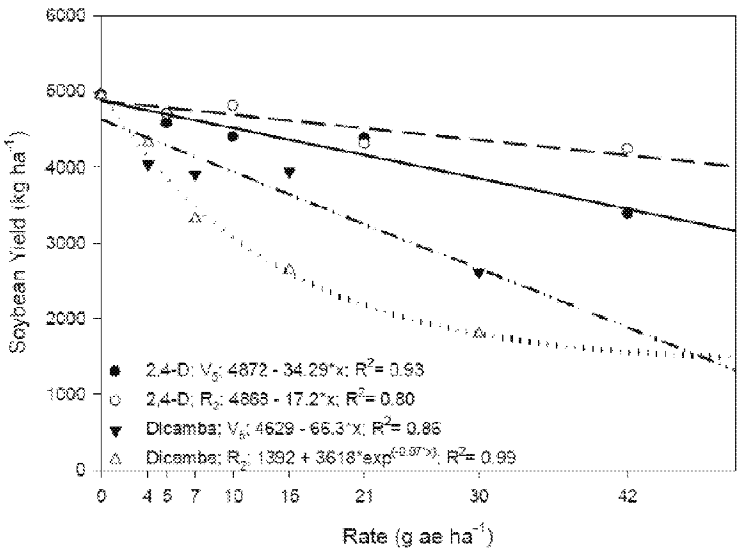

Figure 2 - Soybean yield after treatment of rates of 2,4-D and dicamba applied at the vegetative (V_5) and reproductive (R_2) growth stages.

Additional results and discussion were provided for seedling germination and vigor of seeds obtained from the harvested plants, which had been exposed to dicamba or 2,4-D. Those results are not considered in this review.

Deficiencies/Issues Related to Utility for EPA

- The products applied in this study were not provided.
- The prior history of the field site (i.e., pesticides applied) was not reported
- A randomized complete block design was used in the field; however, no details were provided about how cross-contamination was prevented among the plants in the different groups during the application phase (i.e., the controls, the four different treatment levels, the dicamba and 2,4-D products, and the timing of applications to different growth stages). Furthermore, no details were provided on how cross-contamination was prevented after application given that dicamba is volatile.
- It is unclear how well the nominal application rates consistently represent relative exposure to each plant given that a backpack boom spray was used to apply the test material and no direct measurement of the application rate was provided to confirm that the rate cited in the study was accurate.
- No indication as to how much water was used in the tank mix.
- The method description does not detail the approach taken to ensure consistency in the identification of various injury effect levels.
- Height measurements were on only five arbitrarily selected plants. Although unstated, this presumably means five plants per treatment group.
- It was not stated how many plants were harvested per treatment group for grain yield measurements. It is not clear if yield differences among treatment groups reflected grain yield normalized by plant number or if it also reflected any treatment group differences in the number of plants harvested.
- The analysis did not calculate NOAEC values or ICx values.

- Raw data were not requested from the authors for this review, as a result, while regressions are possible, the statistics generated are more reflective of the central tendency of the model and not measurement or response variability.